F A C T S H E E T

Monticello Mill Tailings Site—Operable Unit III Surface and Groundwater, Soils, and Sediments Baseline Risk Assessment

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Background

The Monticello Surface and Groundwater Remedial Action Project is an environmental cleanup project the U.S. Department of Energy (DOE) is conducting in Monticello, Utah. The project involves investigating and, if necessary, cleaning up contaminated surface water and groundwater at and downstream of the Monticello millsite. It also involves investigating and possibly cleaning up sediments deposited downstream of the millsite along Montezuma Creek. The mill tailings that were eroded from the millsite are the primary source of contamination in surface water, groundwater, soil, and sediment within OU III. These materials carried by Montezuma Creek have been deposited in streambanks or the floodplain for approximately 2.4 miles downstream from the millsite. The cleanup of OU III is being done under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). This law requires that a comprehensive baseline evaluation of risks to human health and the environment be conducted for all CERCLA sites.

What is a Baseline Risk Assessment?

A baseline risk assessment is a systematic process designed to determine the potential risk to human health and the environment from chemicals associated with a contaminated site. The results of risk assessments are used to assist decision making at remedial sites. Specifically the baseline risk assessment is used to:

- determine the need for cleanup
- determine risk levels to human health and environment
- compare the risk reduction achieved by the various cleanup alternatives

How are Risk Assessments Developed?

The four major steps of a *human health risk assessment* are (1) data collection and evaluation, (2) exposure assessment, (3) toxicity assessment, and (4) risk characterization. Data collection and evaluation involves gathering and analyzing site data (See "Fact Sheet: Monticello Surface Water and Groundwater, Findings and Activities" for more information) and identifying potential chemicals of concern. Exposure assessment is done to estimate the magnitude of actual and/or potential exposures, the frequency and duration of these exposures, and the pathways by which humans may be exposed (for example, drinking contaminated water). Two scenarios are used in the exposure assessment: one scenario based on very conservative assumptions (reasonable maximum exposure) and the other based on more typical or likely assumptions (central tendency). A toxicity assessment considers (1) the types of adverse health effects associated with chemical exposures, (2) the relationship between magnitude of exposure and adverse health effects, and (3) the uncertainty associated with the predicted toxicological effects. The risk characterization step summarizes and combines outputs of the exposure and toxicity assessments to estimate the baseline risk to humans.

The evaluation of ecological (plant and animal communities) risk also occurs in four phases: (1) problem formulation, which involves identification of contaminants, examination of contaminant movement, identification of plant and animal communities potentially at risk and exposure pathways, and identification of specific plants and animals of concern; (2) study design, which evaluates characteristics of the site; (3) site investigation, which includes (a) description of sampling and surveying, (b) exposure assessment, which characterizes exposure from all complete pathways, and (c) ecological effects assessment, which compares modeled doses to established values; and (4) risk characterization, which includes an evaluation of the cumulative risk for those plant and animal species of concern and a discussion of the uncertainties associated with estimating risk.

OU III Risk Assessment Results

Human Health Risk Assessment

The human health risk assessment for OU III determined that arsenic, uranium, lead-210, and radium pose the most risk to humans. The pathways by which humans may be exposed to the contaminants at OU III are summarized in the table. Although it is not likely, the risk assessment assumes that contaminated groundwater would be used as a drinking source for potential future residents along Montezuma Creek. Other potentially exposed people are current and future recreational (e.g., hunting) and agricultural workers.

Arsenic and radioactive materials are classified by the U.S. Environmental Protection Agency (EPA) as carcinogens (substances known to cause cancer). The most significant noncancer risk (e.g., skin disease) is caused by arsenic (some substances can cause both cancer and noncancer effects).

Exposure Pathway Analyses Summary

Exposure Medium	Potential Route(s) of Exposure	Potential Receptors	Comments
Air	Inhalation	Future residents, current agricultural workers, and recreational users	Particulate inhalation
Soil and Sediment	Ingestion, inhalation, direct radiation exposure (gamma)	Future residents, agricultural workers, and recreational users	Incidental ingestion, inhalation of dust
Surface Water	Ingestion (incidental)	Future residents, agricultural workers, and recreational users	Exposure through skin is insignificant when compared to ingestion
Groundwater	Ingestion (as a potential drinking water source)	Future residents	Currently not a complete pathway; this is an improbable, but potentially complete future exposure pathway
Beef/Game Tissues	Ingestion	Future residents, agricultural workers, and recreational users	Beef/game are exposed to contaminated vegetation, surface water, and soil

Risks from carcinogenic nonradiological substances (arsenic) are presented as a probability of cancer incidence as a result of exposure. Risks to carcinogenic radionuclides are shown as a probability of cancer mortality. Both of these risk results can be compared to EPA's risk range of 1E–6 to 1E–4. An individual cancer risk of 1E–6 is an added chance of cancer (or mortality for radionuclides) of 1 in 1,000,000 people (1E–4 corresponds to 1 in 10,000 people) attributable to exposure to site-related contamination.

Risks from noncarcinogenic substances were also estimated. The individual risk from all carcinogenic substances are then summed to produce a Hazard Index (HI). When the HI exceeds 1.0, it is a numerical indicator of the transition between acceptable and unacceptable exposure levels.

A dose assessment was also conducted in which effective dose equivalent (EDE) was estimated by adding external radiation plus inhalation and ingestion of radioactive materials that emit radiation to internal organs. EDE may be compared to existing radiation protection benchmarks that specify a total dose of 100 mrem/yr from all sources (excluding background).

The conclusions from the risk assessment are as follows:

- The assumption of potential future ingestion of alluvial groundwater produce added cancer risks exceeding EPA's risk range as well as HIs greater than 1.0. Potential future consumption of alluvial groundwater is the most significant contributor to total risks.
- Exposures associated with Montezuma Creek, including the recreational visits and consumption of muscle tissue from animals grazing there, do not produce added cancer risks exceeding the EPA's risk range and do not produce HIs exceeding 1.0.
- Effective dose equivalent is acceptable.

Overall, risks were estimated using conservative concentration terms and exposure assumptions. All of the substances at OU III that cause adverse impacts to human health are naturally occurring in the environment. The naturally occurring concentrations of these substances are a contributor to total risks. The main risk is from the improbable exposure pathway of future residents using contaminated groundwater as their primary lifelong drinking water supply. Therefore, the potential for excess risk is considered to be low.

Ecological Risk Assessment

Receptors for the ecological risk assessment were selected from wildlife species from the southeastern Utah area on the basis of (1) the species' likelihood of exposure, (2) the species' ecological significance, and (3) the species' sensitivity to contaminant exposure. The wildlife chosen for evaluation were mule deer, deer mouse, aquatic organisms, spotted bat, southwestern willow flycatcher, muskrat, and the peregrine falcon. Risk to these animals was interpreted by estimating the amount of contamination they would be exposed to, evaluating tissue samples, and evaluating population data. Risks to the ecological receptors were found to be acceptable by EPA and State of Utah risk assessors.